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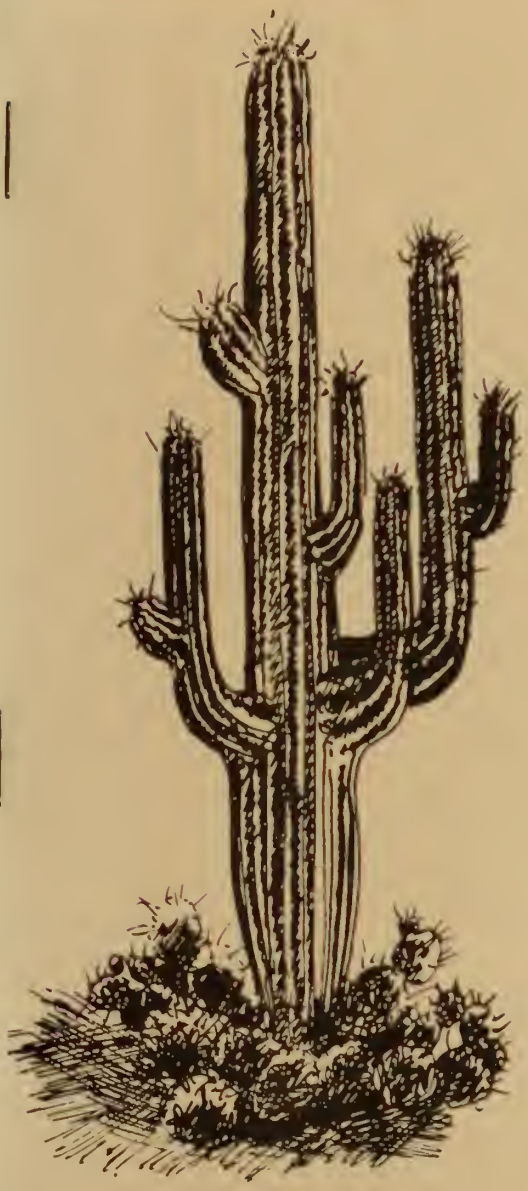

Cooperative National Park Resources Studies Unit

ARIZONA

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AUTECOLOGY OF ARIZONA SYCAMORE
(*Platanus wrightii* Wats.),
A CRITICALLY IMPORTANT SPECIES
IN SOUTH-CENTRAL ARIZONA

by Karen Reichhardt

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A CRITICALLY IMPORTANT SPECIES

IN SOUTH-CENTRAL ARIZONA

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INTRODUCTION

> "The sycamores are the largest trees in the deserts. The palmately lobed to cleft leaves are the largest to be encountered, and the irregularly branched, leaning, white trunks form a remarkable tree skeleton long to be remembered. The sycamores may be recognized also by the chains or series of ball-like clusters of small staminate or pistillate flowers or later fruits."
>
> Benson and Darrow 1945

Thus did two of the Southwest's best known botanists describe the Arizona Sycamore - a tree that is synonymous with the beauty of the riparian landscape in many of the public parks and monuments of south-central and southern Arizona. It is the dominant landscape feature at Montezuma Castle National Monument, Ramsey Canyon Preserve, Madera Canyon and many other less known canyons of Arizona.

The entire life cycle of this stately tree depends on riparian habitat. For an Arizona Sycamore to survive from seedling stage to old age, it must withstand torrential flooding, and the reshaping of the riverbed from the masses of mud, rocks, and debris left by the surging waters. It also must withstand periodic droughts when water is available to the trees only from the shallow groundwater where the roots penetrate an often cobbley substrate. For roots to penetrate these cobbley and rough-textured riparian soils, the soil must be softened by wetness. If the floodplain has been downcut, trees that once germinated on seedling nursery bars (sand or gravel bars in the stream channel which have been scoured by flood, thereby providing suitable conditions for germination) may be left high and dry with only the roots in groundwater on the high terraces. Regeneration then only takes place by basal sprouting. In some places the Arizona Sycamore does not appear to be regenerating at all (Glinski 1977). It comprises 4% of the wetland vegetation in Arizona and is considered to be one of the ten most successful riparian trees in Arizona (Rodiek 1981).

The Arizona Sycamore has been variously named the Arizona planetree, alamo, sycamore, buttonwood, and planetree (Lehr 1978, Little 1979). It was first collected by Charles Wright in 1851 during an expedition to the southwest where he collected many specimens, including the type specimen for Arizona Sycamore (Little 1979). The Latin name for the species is *Platanus wrightii* wats. and the synonym is *P. racemosa* Nutt. var. *wrightii* (Wats.) L. Benson. It is distributed throughout riparian habitats from 1,000 to 6,000 feet from southern California to Arizona, southwestern New Mexico, and northern Sonora and Chihuahua (Little 1979, Benson and Darrow 1945). The

tree reaches 24 meters tall "with beautifully arched, white-barked branches" (Kearney and Peebles 1960). Its wood is reddish brown, coarse grained yet clean appearing, and difficult to split or work, although it decays easily and is not suitable for outside uses (Collingwood et al. 1974).

DISCUSSION

PHYLOGENY AND PALEOECOLOGY

According to Holstein (1984) the genus *Platanus* belongs to a family of deciduous trees having unisexual flowers and wind dispersed fruits, which were common during the Arcto-Tertiary age (the beginning of the Tertiary which was 63 million years ago). The dominant trees of north temperate forests display these same features. *Platanus* is less common than it was during the Arcto-Tertiary and is now restricted to wetlands of warm temperate to tropical climates (Holstein 1984). Holstein (1984) cites a German reference which reports Arcto-Tertiary fossils of sycamore as far north as Greenland.

The closest relative of *P. wrightii* is *P. racemosa* which is in California, where some gradations between the two species can be found. Holstein (1984) conjectures that the two species were once more closely related but separated as the desert expanded and isolated the woodlands. The two species are more closely related to *P. orientalis*, which is found in southeastern Europe and the Himalayas, than they are to *P. occidentalis*, which is in the east. All are found in riparian zone habitats (Holstein 1984). *P. occidentalis* is the most ponderous American hardwood and reaches 18 to 36 meters high and up to 4 meters in diameter, with irregular buttresses (Collingwood et al. 1974).

POLLINATION

All species of sycamores are popularly thought to be wind pollinated (anemophilous).

PHENOLOGY AND SEED PRODUCTION

Adams (1985) observed the phenological pattern of Arizona Sycamore in two riparian sites in southern Arizona. Visible signs of ceased shoot growth, indicating dormancy, were observed in August. Leaves emerged and stems began to elongate in March. Kearney and Peebles (1960) report flowering in April and May. Seeds in the form of achenes with tufted hairs fall from the trees from January to March and are wind dispersed (Bock and Bock 1985). Fowells (1965) reports that for *P. occidentalis*, trees begin bearing seed at age 25 and optimum seed production is from age 50 to 200, with good seed crops every 1-2 years. The yield is 200,000 seeds per pound.

Seed dispersal of Arizona Sycamore was measured by Bock and Bock (1985). Each capitulum contained an average of 667 achenes[1], and one individual tree sheds an average of 449 seeds per square meter. Viability is 90%. They are spread in a pattern around the trees, 90% of the seeds falling between 10 meters upstream and 16 meters downstream.

GERMINATION REQUIREMENTS

The following optimum germination requirements have been established by Siegel and Brock (in press) for Arizona Sycamore: 1) 27 degrees Centigrade; 2) 0 water stress; 3) 0 salinity; 4) 5 to 7 pH. This species had the narrowest requirements for successful germination responses to varying temperatures, water stress, salinity, and pH levels of any of the Arizona riparian species tested, including cottonwood, willow, mesquite, and others. Literature on *P. occidentalis* emphasizes that sycamore seed germination is low, and moist mud flats along the streamside are a necessity for reproduction (Harlow and Harrar 1968, Collingwood et al. 1974).

Sycamore seeds failed to germinate while soaked in water for up to 32 days, but germination was rapid and higher than for unsoaked seeds after removal from water (Hosner 1957). Thus, flooding does not have an effect on seedling survival if the floodwaters recede after a reasonable period of time. Basic germination requirements in silviculture are: 30 days stratification at 46 degrees Fahrenheit; light stimulation; and moisture (Fowells 1965).

In the natural setting of Sonoita Creek, Santa Cruz County, Arizona Glinski (1977) reports difficulty of seed germination - "perhaps the soil chemistry of the eroded valley floor has changed significantly and now inhibits either germination of seeds or growth of seedlings". My own interpretation would be that moisture requirements are so narrow that germination is an infrequent occurrence which takes place only when receding waters leave a suitably moist nursery bar. Brady et al. (1985) showed that nursery bars are essential to germination and seedling establishment, and that this does not occur on an annual basis.

SEEDLING DEVELOPMENT

Seedlings growing in pots of saturated soil developed adventitious roots after 38 days. If inundated by flooding, some stunting occurs but recovery is rapid (Fowells 1965). In a natural situation in southern Arizona, seedlings did not survive

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[1] Each achene is considered a one-seeded fruit.

the flooding and desiccation of the riparian setting except where a perennial spring kept the soil moist. Seedlings that germinated in the moist soils of the permanent spring were 100 times more numerous than saplings, indicating that survival to sapling stage is low (Bock and Bock 1985). At Sonoita Creek, Glinski (1977) proposed that "the absence of sycamore seedlings may be related to the erosion and turbid flooding that now periodically occurs in this drainage".

COMPETITION/LIGHT REQUIREMENTS

Fowells (1965) reports that sycamore seedlings grow better in full light than half-shade; the root system penetrated deeper into the soil and was more branched when growing in the full light conditions. In southern Arizona, Arizona Sycamore saplings were more common away from the tree canopy. In general, the sycamores are considered to be intermediate in tolerance to shading by other tree species and in competitive ability (for sunlight), although some authors consider it to be intolerant (Fowells 1965). Barrett (1980) considers the *P. occidentalis* to be a favorable tree in management because it is tolerant to competition as well as having other useful attributes.

ULTIMATE AGE

I could find no reports in the literature of the ultimate age of Arizona Sycamore. Tom Harlan of the Laboratory of Tree Ring Research at the University of Arizona communicated to me that there are few tree ring data for Arizona Sycamore. Few hardwoods give reliable dates because they have inter-annual rings. Sycamore is especially difficult to date because many trees are rotten inside. A rough estimate of age would be possible by sampling from the outside portion of a tree to make a core. One could then reconstruct the probable age of the tree based on the outside ring numbers and the overall diameter of the tree.

VEGETATIVE REPRODUCTION

Individual trees may reproduce vegetatively by basal sprouting from the stump. This allows the species to continue to survive on high terraces where they would otherwise not reproduce from seeds. Root or trunk sprouts were found on 74% of mature sycamores in Sonoita Creek, where 39% of the trees had root sprouts, 56% had trunk sprouts, and 22% had both trunk and root sprouts (Glinski 1977).

Glinski (1977) was unable to determine why sycamores sprout. I do not know how long clones continue to reproduce in this manner or how long a population of Arizona Sycamore will remain viable

through basal sprouting. Glinski (1977) and Laurenzi (1982) both found the trees growing in clumps which were all apparently clones of the same parent. Laurenzi (1982) maintains that they will continue to reproduce indefinitely in this manner. Glinski (1977) believes that water must continue to be present below the surface.

REGENERATION

I found several references stating that Arizona Sycamore is regenerating itself in the Arizona riparian habitat only slowly, if at all (Rucks 1985; Barstad 1981; Bock and Bock 1985). Rucks (1985) states that "size-class distribution is the reverse of one needed to maintain the species in the community in Arizona streams." "Sycamore was not capable of maintaining itself... perhaps because it is intolerant of the present conditions" was the conclusion made by Barstad (1981). Both Glinski (1977) and Shanfield (1984) indicated that clonal regeneration would insure that the sycamore continue to grow naturally in Arizona. Grazing tends to prohibit seedling survival in many sites (Rucks 1985; Glinski 1977; Shanfield 1984). Degradation and downcutting of the riparian habitat is also blamed for low regeneration rates (Laurenzi 1982; Barstad 1981; Glinski 1977).

WATER REQUIREMENTS/ADAPTATIONS

Arizona Sycamore and the California Sycamore are both adapted to moist habitats and intolerant of drought stress. The trees are kept alive by shallow groundwater and surface water flows. As is characteristic of many wetland species, their roots have cortical air spaces to improve oxygenation while saturated (Groenveld and Griepentog 1985). The preference for dry porous sites within the riparian zone indicates that aeration is also a requirement (Holstein 1984). Moisture requirements for propagated trees are considered to be high. The Arizona Sycamore tolerates heat when sufficiently watered in an urban setting (Rodiek 1981).

PROPAGATION

Plants may be propagated either by seed germination (see section on Germination Requirements) or by cuttings. The greatest results for cuttings are from one year old vigorously growing seedlings, for which there is a 66-80% success rate (Fowells 1965). Fowells (1965) suggests fall plantings of cuttings made close to the root collar that are 20 inches (50.8 cm) long, buried 15 inches (38.1 cm) into the ground.

For areas in Arizona where groundwater is 7-12 feet (2-4 meters) below the surface, a new method of propagation has been tried

that might be successful with Arizona Sycamore. Twenty foot (6 meter) long poles were planted in drilled holes with 4-6 feet (1.2-1.8 meters) extending above the ground, leaving 14-16 feet (4.3-4.8 meters) below ground and penetrating into the groundwater. Poles were 2-3 inches (5-8 centimeters) in diameter. They showed a greater chance of survival if a portion of the poles were in saturated soils year around (Swenson and Mullins 1985).

DISEASES

The most serious disease affecting sycamores is an ascomycete fungus (*Gnomonia platani*) which causes a kind of anthracnose disease (Pirone 1970; Holstein 1984; Fowells 1965; Boyce 1961). Susceptibility to the disease is greatest during cool wet spring weather, and California Sycamore populations are apparently limited at the northwest edge of their range by the fungus (Holstein 1984). "Trees may be practically defoliated" (Streets, 1984). The symptoms first appear in spring on young leaves as they are unfolding, and appear to be frost damaged. Later in the season, cankers form on the small twigs and water sprouts develop, causing bunchy growth. Minute pimples erupt from the bark in the following year. Leaves may become blotched and eventually fall from the trees. Prevention and control is promoted by destroying fallen leaves, pruning and destroying the infected twigs, and spraying with an acceptable fungicide (Boyce 1961; Pirone 1970).

Another fungus was recently discovered that uses Arizona Sycamore as a host (Bursdall and Gilbertson 1974). This is *Phanerochaete allantospora* and it "is associated with a white rot of slash and dead branches on trees and shrubs in the Sonoran Desert". *Phanerochaete arizonica* was also found on Arizona Sycamore and follows a similar growth form, but is more common. No recommendations on control were given by the author.

HABITAT REQUIREMENTS

The underlying requirement necessary for the survival of sycamore and other riparian species is water. The water table must be close to the surface for the riparian community to exist (Zimmerman 1969). Specific habitat differences within the riparian corridor where groundwater is available, e.g., soil texture differences, perennial or intermittent above groundwater flow, the extent of flooding, deposition of nutrients, and channel changes by flooding, all are major factors influencing the distribution of plant communities.

In central Arizona, sycamore is associated with valley fill areas having perennial, intermittent, or semi-perennial streams where

the species is distributed evenly between low and high level terraces on beds of coarse porous sand and gravel (Laurenzi 1982). Cottonwood and willow are more restricted to those streamside habitats where the alluvial soils are fine grained, and where excessive flooding causes inundation and high moisture conditions on a periodic basis (Laurenzi 1982).

The sycamore populations on the higher terraces are able to persist and reproduce indefinitely by basal sprouting where surface moisture is otherwise not sufficient for seed germination. Glinski (1977) suggests that subsurface moisture may be a key factor that induces basal sprouting. The higher terraces are more xeric and are the result of channel flooding and downcutting of the surface level.

Glinski (1977) notes that "where channeling has increased the depth of the water table and prevented lateral flooding onto benches, the only moisture available to vegetation on these benches may be from precipitation. For cottonwoods and sycamores this may not be sufficient to sustain growth, especially if bench alluvium and topography permit rapid runoff of precipitation. If mature sycamores require saturated alluvium for sprouting, the frequency of sprouting may decrease with increased erosion."

MANAGEMENT CONSIDERATIONS

Following are recommendations for maintaining the stand of Arizona Sycamore at Montezuma Castle.

1. Drill holes to determine the depth of the water table in the places where the trees are wanted, if this information is not currently available, and record the water table depth on a year around basis because the water table fluctuates.

2. Research instream water rights to ensure that the water table does not drop lower than the sycamore root zone sometime in the future.

3. Map the canopies of the existing sycamores, because newly planted trees will be more likely to survive away from the canopies of mature trees.

4. Research how long the population might survive with basal sprouting given the present conditions - if they continue to survive and the water conditions remain the same, there may not be reason to plant new ones.

5. Continue to treat for anthracnose if needed - I could find no reference to ecological approaches for treatment of this disease but my guess is that they require nutrient rich soils because the floodplain under natural conditions would leave nutrient rich detritus following major floods.

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